



Intelligent Voice Interactive Systems for Damage Control Training

Stanley Peters

Professor of Linguistics and
Symbolic Systems

Stanford University

USS Cole DDG 67



30 March
2004

Navy Workforce
Research & Anal

Damage Control Training

- Navy has long recognized need to train Damage Control Assistants (DCAs) under realistic, stressful circumstances.
- Requirement for realistic experience of damage control and opportunities to integrate schoolhouse knowledge and apply it in a practical situation, without the cost of bringing an entire ship to general quarters.

Automating Spoken Critiquing/ Mentoring in Damage Control

- SCoT DC – Voice interactive intelligent tutoring system, under development in an ONR sponsored MURI project.



- DC Train – Demonstration of concept system employing AI and simulation to afford student DCAs wide variety of realistic damage control exercises.



- IDCTT – Prize-winning multimedia demo

Integrated Damage Control Training Technology (IDCTT)

- IDCTT used immersive multimedia – bombarding the student with multiple information reports in both audio and video – to address need for training DCAs under realistic, stressful circumstances.
- Well received by SWOS and ATGPAC, but supported only one exercise (damage scenario).
- Many varied damage control exercises required for training in damage control.

DC Train

- Office of Naval Research funded advanced technology development of an Intelligent Computer Assisted Instruction system (aka Intelligent Tutoring System) at University of Illinois to put flexibility and intelligence behind the façade of IDCCT.
- DC Train employs artificial intelligence and computer simulation in addition to multimedia and graphical visualization technology to provide student DCAs with an intensive, realistic experience of coordinating ship damage control in a large number and wide range of damage scenarios involving fire, smoke, and flooding.
- Trains DCA in his or her whole task by intelligently simulating other damage control personnel as well as ship systems and the spread of damage.
- Supports detailed assessment of student actions as correct, error of commission, error of omission, etc. by intelligently solving DCA's problem itself.

DC Train

The screenshot displays the DC-TRAIN 4.0 software interface, which is divided into several functional panels:

- Main Panel:** Contains tabs for Main, Hazard, Firemain, Ship Display, History, Stop, Restart, and Close.
- MessageBanks Panel:** Shows incoming and outgoing messages. Incoming messages include reports from CO, CIC, and DCCO. Outgoing messages include reports from RepairLocke2.
- ShipDisplay MDI Window:** Displays a 3D wireframe model of a ship's hull and internal compartments. A red area highlights a specific compartment, and coordinates 42540-E and 4740-E are visible.
- Phone Takers Panel:** Displays a text message: "General Quarters! General Quarters! All hands man your battle stations. Set material condition Zebra throughout the ship. Make Zebra reports to DC Central." Below the message are icons for various personnel: IMC, DCCO, EOOW, NET80, Repair2, Repair3, and Repair5.
- Firemain Panel:** Shows a detailed view of the ship's firemain system, including fire zones (1, 2, 3, 4), pumps, hydrant actuators, and various valves (FMV, DISCH, PRESS, LOW, OFF). It also includes a "HAZARD DETECTION PANEL" with a grid of fire zone indicators and a status bar at the bottom.

30 March
2004

Navy Workforce
Research & Anal

Evaluation of DC Train (Dr. Janet Sniezek)

- DC Train (and IDCTT) successfully approximate the stressful environment of damage control by bombarding the student with multiple information reports in both audio and video.
- After four exercises with DC Train, students' anxiety levels did not decrease significantly.
- Trainees reported high levels of effort, anxiety, time pressure and mental demand.

Transition to Mentoring

- Stanford using DC Train as platform for research on the use of natural language in instruction. (Stable base for experimentation.)
- We enhanced interface so student can speak to DC Train, like a DCA aboard ship.
- Our research is on intelligent tutoring (critiquing) after a damage control exercise to give the student much improved feedback.
 - ✦ Interactive, spoken, after action review of training session.

DC Train (voice enabled)

- Video clip here

Spoken Critiquing of Damage Control by SCoT DC

- Video clip of SCoT DC here

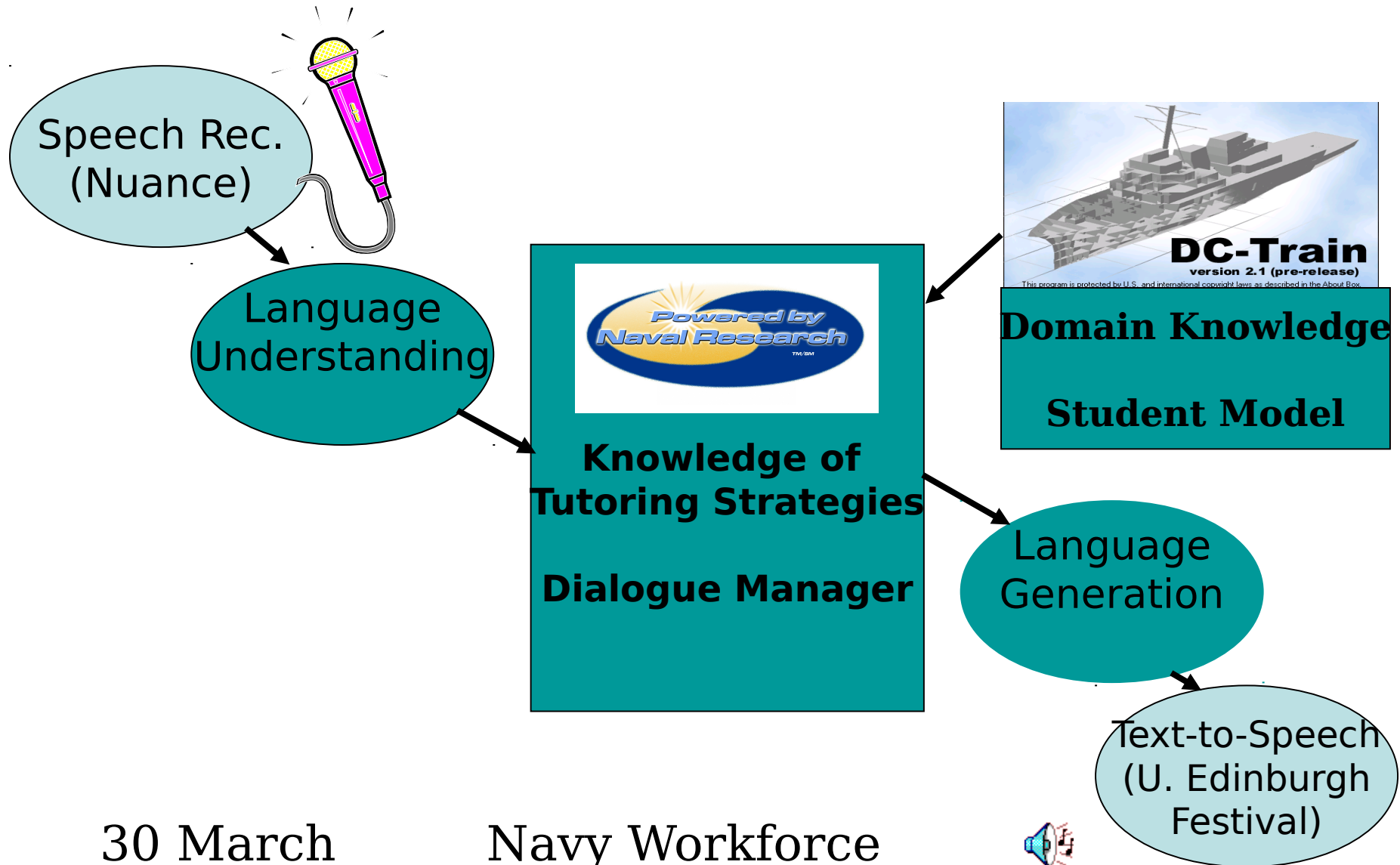
www-

csli.stanford.edu/semlab/muri/Nov2002Demo.
html

After Action Review

- Shipboard damage control is
 - Fast-paced, stressful & high-stakes – lives at risk
 - Grounded in time & space
 - Extremely complex and difficult
 - A multi-modal task
- Tutor emphasizes performance assessment, post-session critiques
 - Typical of in-person military training for such tasks
 - Too much going on during task performance
 - Reflective discussion after problem solving has been shown to improve students' mastery of some subjects (electronics, physics)

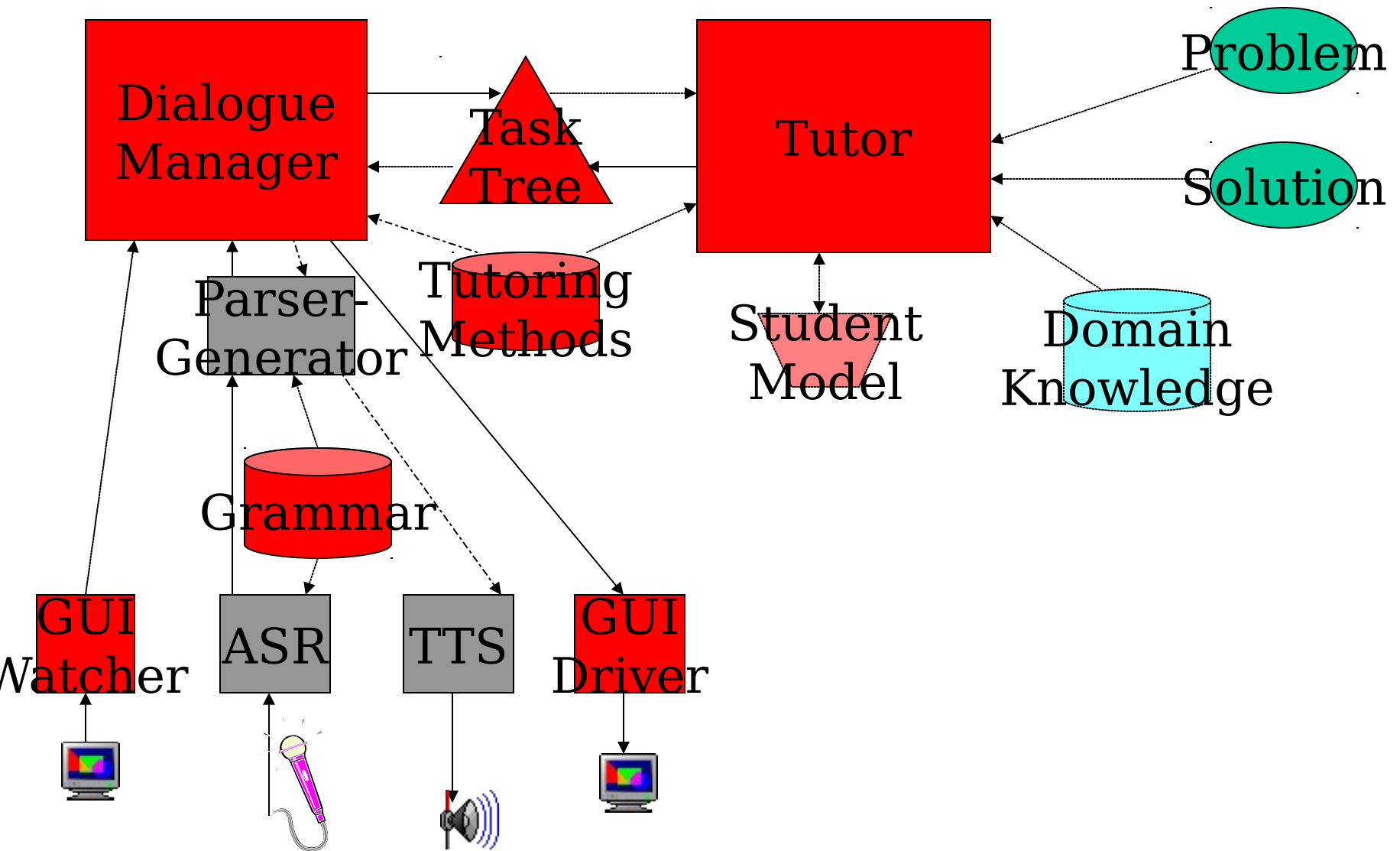
Tutorial Dialogue for Damage Control



30 March
2004

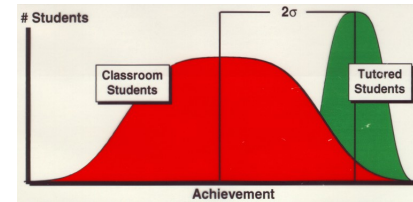
Navy Workforce
Research & Anal

Stanford NL Reflective Tutoring Architecture



Why Natural Language?

- Understanding the student's answers, questions, and explanations supports detailed diagnosis of gaps and confusions in knowledge, preparing the tutor to respond with helpful hints, guidance, and information.
- Individual human tutoring is outstandingly effective – at least a 2 SD improvement over classroom instruction (e.g., SAT of 500 vs. 700).



- Artificially intelligent tutors are halfway there – 1 SD improvement.
- Natural language interaction ability is the most salient difference between human and SOA artificially intelligent tutoring systems.

Office of Naval Research

Two MURI projects on NL interaction with ITS

- Stanford University – University of Illinois
 - Damage Control
- University of Pittsburgh - University of Memphis
 - Physics
 - Basic computing

Sim Game w/Agents + Intelligent Tutoring

- Use to prepare students for courses
- Use during courses for students to practice without constant supervision from instructors
- Use for periodic testing in level of proficiency
- Use by already qualified personnel to maintain proficiency

State of DC Train

- DC Train is now stable
- Several dozen DC exercises are available
 - developed by former Navy DCAs
- Could be used ‘as is’ for some training
- For general training use, this concept demonstration system should be rebuilt, based on lessons learned, with capability to simulate many ships.

State of SCoT DC

- Research system, now being tested in experiments to measure student learning gains
- Provides rich feedback and guidance to a student through interactive discussion of his/her performance in practice session
- Demonstrates that student speech (vs. typing) has an important place in instructional technology
- Employs a generic architecture that is portable to instruction of other subjects (cf. domain specific knowledge, language, possibly tutoring methods)

In Closing

- ONR is leading research on NL-capable ITSs
- ITSs can fill important role in Navy's system for effective, efficient, high-quality training of officers and sailors, and soon will have NL capabilities.